Laser Demonstration System Options

- Laser WPT from ISS to ground
  - Approximately 5 kW available input power (constrained by ISS external facilities)
  - Requires Laser WPT module, not a full WPT spacecraft
  - Requires ground receive system
  - No free-flying receive spacecraft required
  - Lowest cost demonstration option ?
  - ISS integration issues
- Laser WPT from ISS to spacecraft
  - Approximately 5 kW available input power (constrained by ISS external facilities)
  - Requires Laser WPT module, not a full WPT spacecraft
  - Requires free-flying receive spacecraft
  - ISS integration issues
- Laser WPT from space to ground
  - Power level TBD (up to 100 kW, constrained by desire for single launch)
  - Requires free-flying WPT spacecraft in LEO (orbit TBD)
  - Requires ground receive system
- Laser WPT from space to space
  - Power level TBD (up to 100 kW, constrained by single launch for both spacecraft)
  - Requires free-flying WPT spacecraft in LEO (orbit TBD)
  - Requires free-flying receive spacecraft

Microwave Demonstration System Options

- Microwave Beam Calibration from ISS to ground
  - Approximately 5 kW available input power (constrained by ISS external facilities)
  - Does NOT provide useful power, only beam calibration
  - Requires Microwave WPT module, not a full WPT spacecraft
  - Requires ground receive system
  - No free-flying receive spacecraft required
  - Lowest cost Microwave demonstration option ?
  - ISS integration issues
- Low-Power Microwave WPT from ISS to spacecraft
  - Approximately 5 kW available input power (constrained by ISS external facilities)
  - Requires Microwave WPT module, not a full WPT spacecraft
  - Requires free-flying receive spacecraft
  - ISS integration issues
- Microwave WPT from space to ground
  - Power level TBD (up to 100 kW, constrained by desire for single launch)
  - Requires free-flying WPT spacecraft in LEO
  - Requires Ground receive system
- High-Power Microwave WPT from space to space
  - Power level TBD (up to 100 kW, constrained by single launch for both spacecraft)
  - Requires free-flying WPT spacecraft in LEO (orbit TBD)
  - Requires free-flying receive spacecraft

Additional Demonstrator Mission Options

- Use WPT power to perform experiments on receive spacecraft
- Use array power to perform experiments on WPT spacecraft
  - High-power communications
  - Space-based radar
  - Manufacturing
  - Propellant production
  - Space science
  - Others
- Use WPT power from WPT spacecraft
  - Laser annealing of solar arrays
  - Provide energy and control to solar sails
  - Rover demonstration
  - Others
- Use array power or WPT power for electric propulsion transfer
  - Possible initial orbits: ISS, LEO 28.5 deg, Sun-Sync
  - Possible destinations: GEO, HEO, E-M L1, E-S L2, Moon, Mars, Van Allen Belts, Asteroids, Comets

Technology Flight Demos
Discussion Topics

- **Question:** In the proposed ISS power beaming experiment, why must one satellite be both the power beaming receiver and the 100 kW platform for the tech. experiments?

Two different sats may make more sense. The ISS beaming experiment could be relatively simple, and could beam to a site on Earth. Use an existing beam expander (small enough to go through the JEM airlock) to put a 3m spot on ground, with power received on PV array. Could also demo retrodirective beam experiments.

Technology Flight Demos
Discussion Topics

- **Question:** Should we only work laser experiments for the 1st demo?

- *Suggestion to have a credible laser demo for WPT, since concerns about what would be credible for a low power microwave demo*
- *Suggestion to leave both options open now, since laser impacts not fully understood. Do more work, then downselect technology.*
- *What about a combined laser/microwave experiment? Could demo both systems, but issues include efficiency losses of laser into microwave*

Technology Flight Demos
Discussion Topics

- **Question:** Should the ISC configuration be used for the 100 kW tech. demonstrator?

ISC is complex and technically challenging, so a simpler bus may make more sense. Salient features of the ISC could be demonstrated in a small experiment on the tech. demonstrator.

Technology Flight Demos
Discussion Topics

- **Question:** What about cooperative work with DARPA, to demo WPT to one of their sats?

Erectorset on-orbit assembly may be a candidate. WPT transmission to Orbital Express? May need 2nd copy of satellites, due to 1 year life of Orbital Express sats.